Vaca Muerta: “Getting Ready for Full Development”

May 2018

Pan American ENERGY

Energía que evoluciona

Agenda

Vaca Muerta: “Getting Ready for Full Development”

1. Who we are?
2. What we are doing?
3. How we are doing it?
4. Future Challenges

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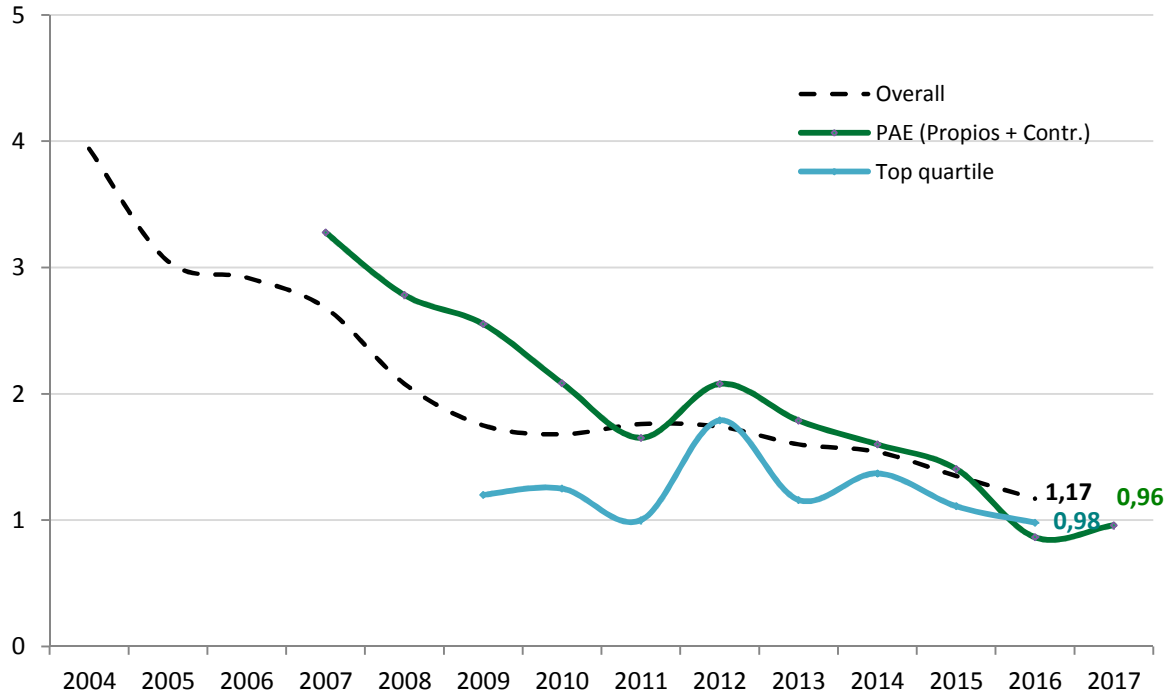
TRICF PAE vs IOGP

Total Recordable Incident Case Frequency – PAE /Contractors

per million man hours worked



	IOGP		PAE	
Año	**Top quartile**	**Promedio**	x 200,000hh	x 1.000,000hh
2016	0,98	1,17	*0,173*	0,865
2015	1,11	1,35	*0,281*	1,41
2014	1,37	1,58	*0,32*	1,6
2013	1,16	1,64	*0,358*	1,79
2012	1,79	1,94	*0,416*	2,08
2011*	1,00	1,92	*0,33*	1,65
2010	1,25	1,68	*0,417*	2,08
2009	1,2	1,75	*0,511*	2,55
2008	*N/A*	2,08	*0,556*	2,78
2007	*N/A*	2,68	*0,656*	3,28

(*) Desde el año 2011 la medición de IOGP distingue entre compañías con < 50Mm HH de aquellas con > 50MM HH.

TRICF PAE al 31/12/2017: **0,192**
(**0,96** por cada 1.000.000 de HH)

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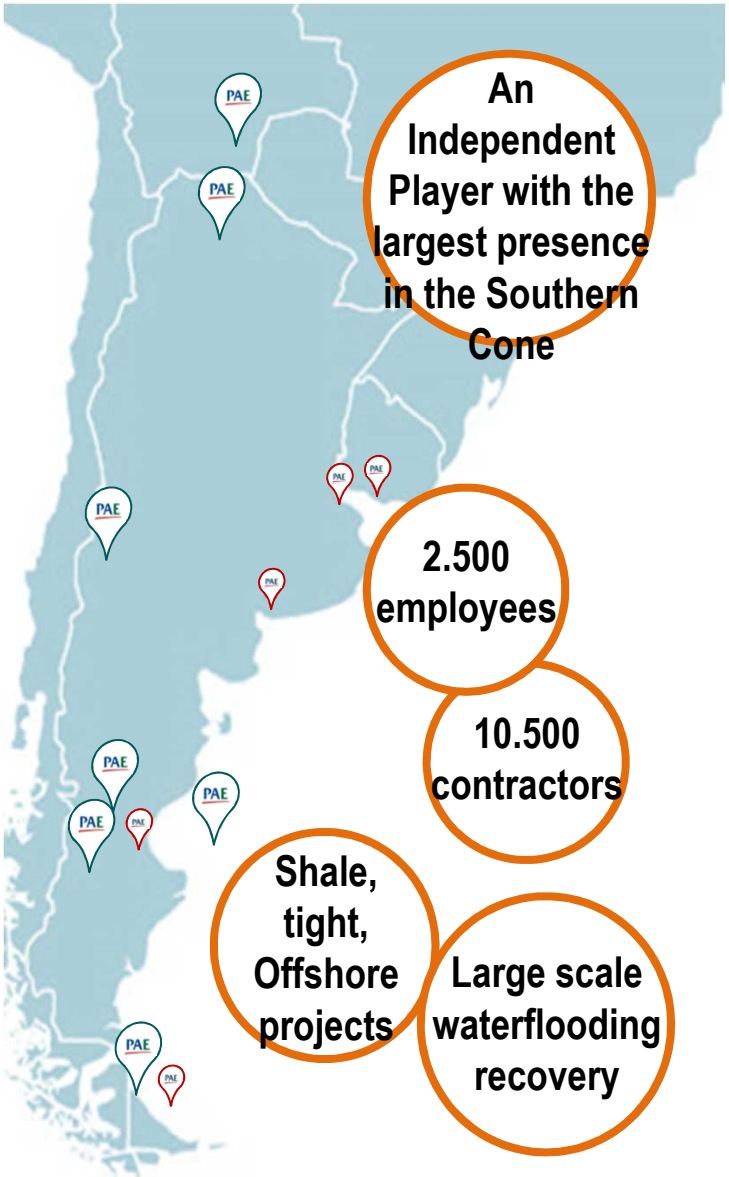
Who we are - An Upstream, Midstream & Downstream active player



Upstream

108 Mbd
Oil production

23,6 MMmcd
Natural gas production

1.562 MMbpe
2017 Certified Proved Reserves (SEC)

786 MMbpe
2017 Certified Probable & Possible Reserves (SEC)

18% Argentina Market Share

70/30 oil to gas P1 + P2 reserves ratio

Midstream y transformation

3 Oil tanking terminals

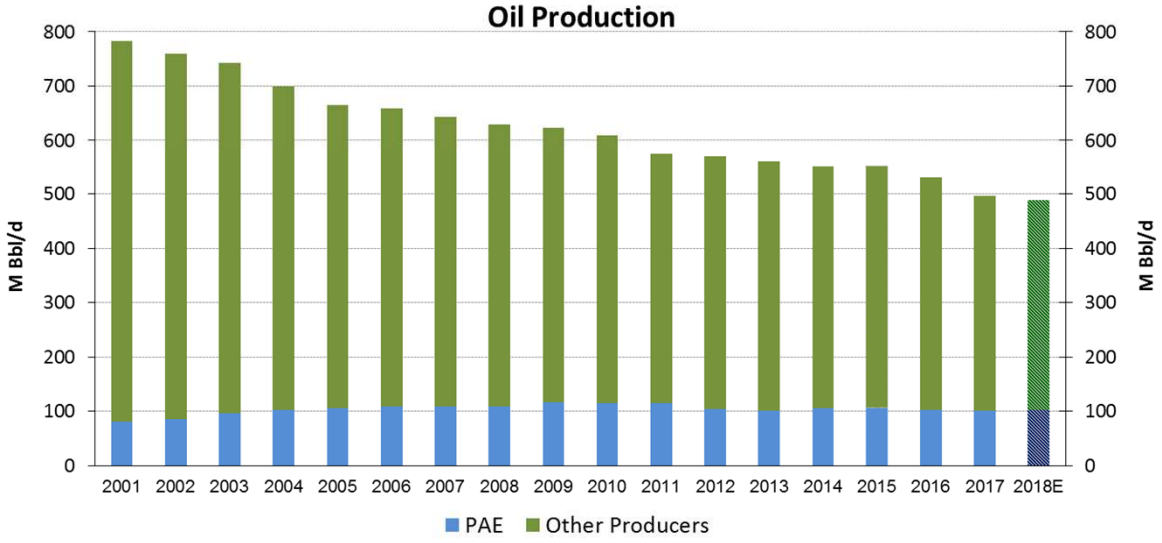
Main Pipelines participation

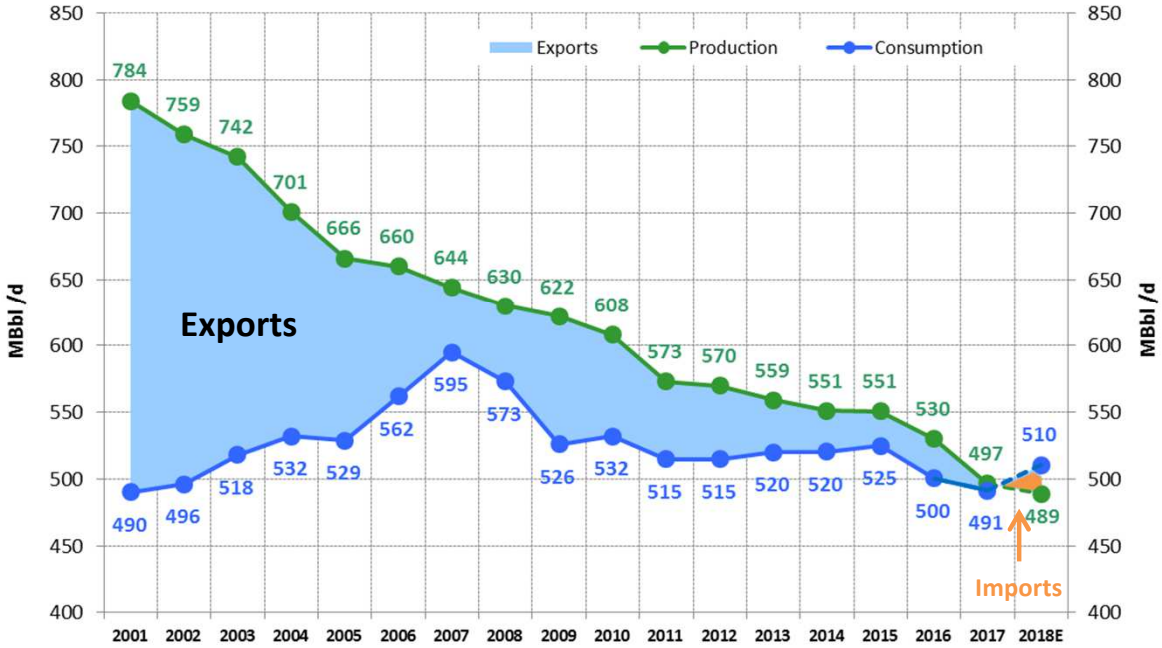
Power Generation
Thermal & wind generation

Downstream

1 Crude Oil Refinery
750 retail sites in Argentina, Uruguay & Paraguay

Argentina - Oil Production vs Consumption





2017 vs. 2001

- **PAE Growth: 24%**
- **Other Producers Decline: - 44%**
- **Argentina Decline: - 37%**

2017

Crude Oil Exports: 10 MMBbl
(PAE 9 MMbbl)

Imports by product: 23,9 MMBbl

- Diesel: 13,4 MMBbl
- Gasoline: 2,6 MMBbl
- Light Crude: 7,9 MMBbl

Note: Volumes of Diesel imported for power generation, not included

Note: Argentina has a surplus of heavy crude oil that is exported, but it does not produce enough light crude oil which is imported.

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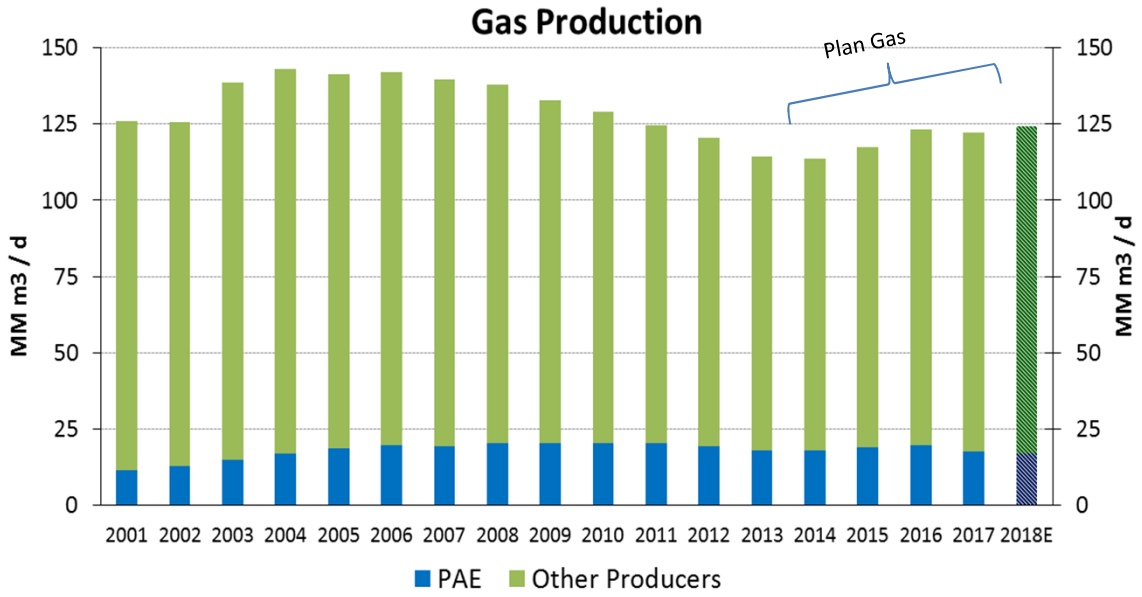
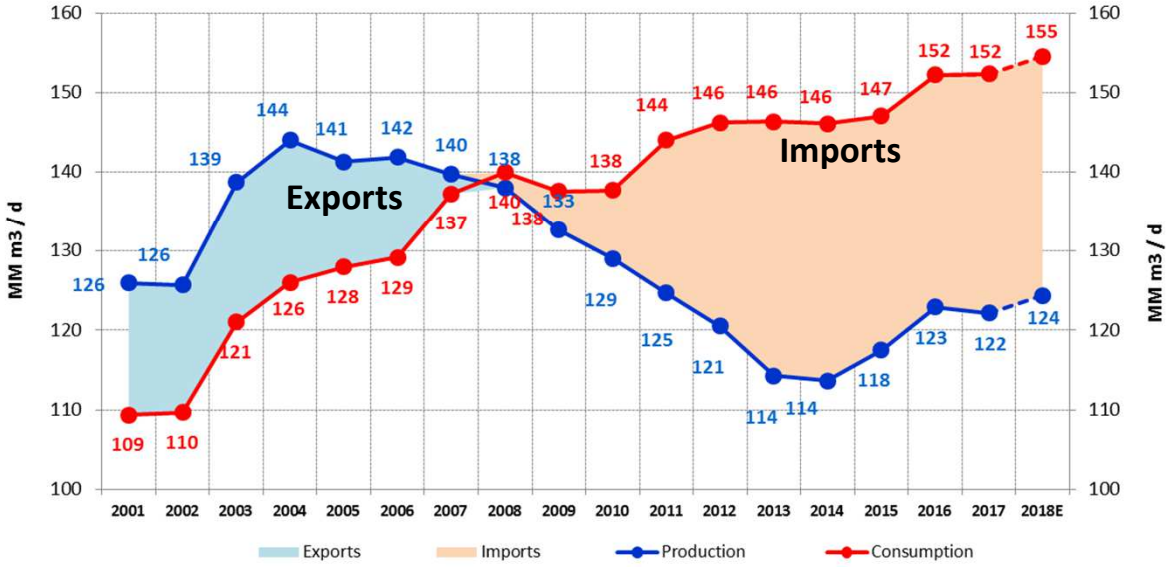
Argentina - Gas Production vs Consumption





2017 vs. 2001

- PAE Growth: 62%
- Other Producers Decline: - 9%
- Argentina Decline: - 3%

2017

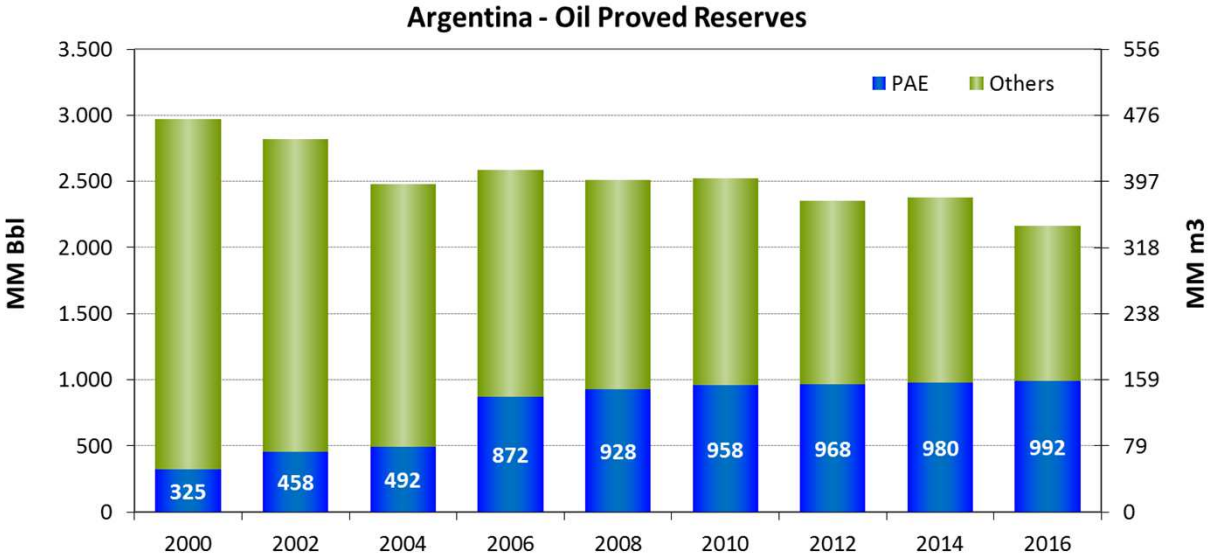
Gas Imports from Bolivia

18,1 MMm3/day

LNG Imports

12,2 MMm3/day

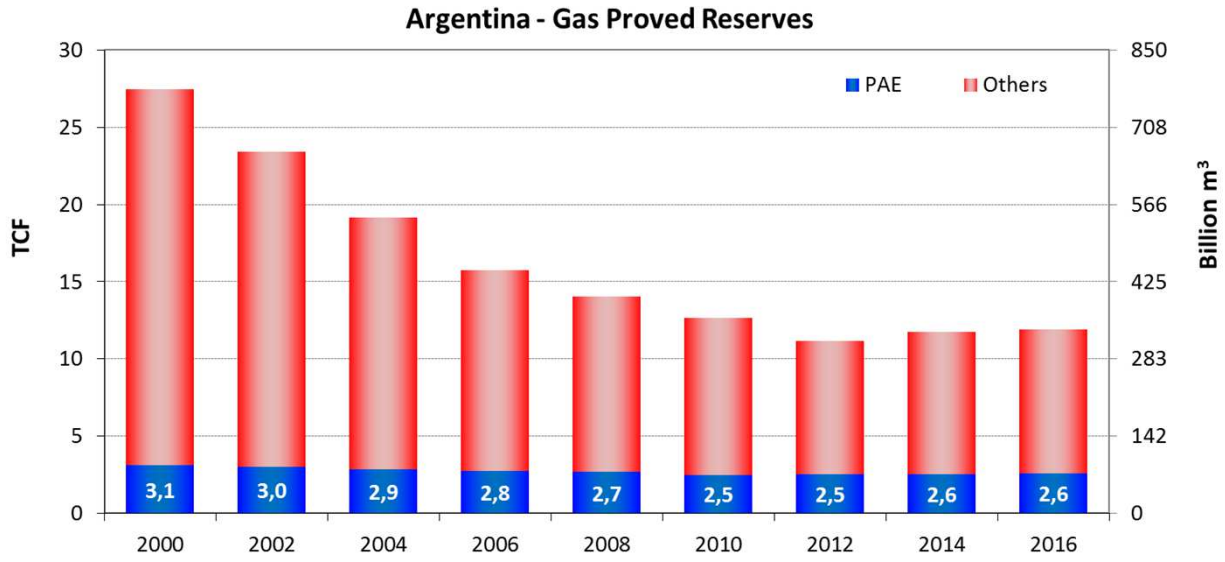
Who we are - Reserves



2016 vs 2000 Oil Proved Reserves:

Argentina -27%

PAE +205%



2016 vs 2000 Gas Proved Reserves:

Argentina -57%

PAE -16%

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Upstream Assets

Basin	2017 Production - Net PAE		
	Oil (M Bbl/d)	Gas (MMm3/d)	Total (M BOE/d)
Golfo San Jorge	95,7	8,8	149,5
Austral	2,2	5,2	34,1
Neuquina	1,5	4,1	26,4
Noroeste	6,5	5,8	41,6
TOTAL	**105,9**	**23,9**	**251,5**

Note: LPG and Cerri not included, Noroeste includes Caipipendi

Basin	2017 SEC Proved Reserves - Net PAE		
	Oil (MMbbl)	Gas (Bcm)	Total (MM BOE)
Golfo San Jorge	935	31	1.125
Austral	9	24	152
Neuquina	9	17	109
Noroeste	24	25	175
TOTAL	**977**	**96**	**1.562**

Note: Noroeste includes Caipipendi.

References

- On-Shore / Operated Asset
- On-Shore / 3rd Party Operated Asset
- Off-Shore / Operated Asset
- Off-Shore / 3rd Party Operated Asset
- Renewable energy / Operated Asset

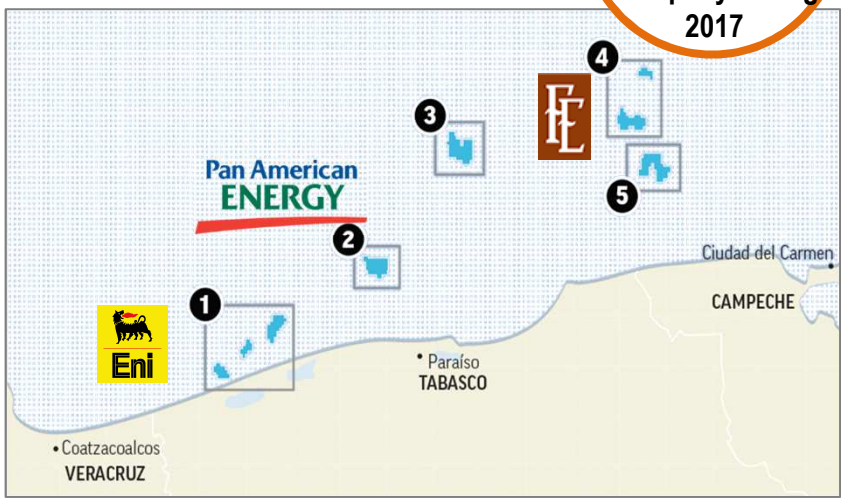
Who we are - Offshore Mexico & Cuenca Marina Austral

Mexico

- Hokchi Block: Awarded in Round 1, with an area of 40 km2 and located 30 km from Dos Bocas Harbour. An oil prospect with reservoir at 2500 meters depth.

Five wells drilled

Largest investment from a Private Latin American Company during 2017



Blocks 3 & 5 not awarded

Cuenca Marina Austral

- Partnership with TOTAL & Wintershall.

Largest offshore Operation in Argentina

Vega Pleyade Project: Initial Production in 2016

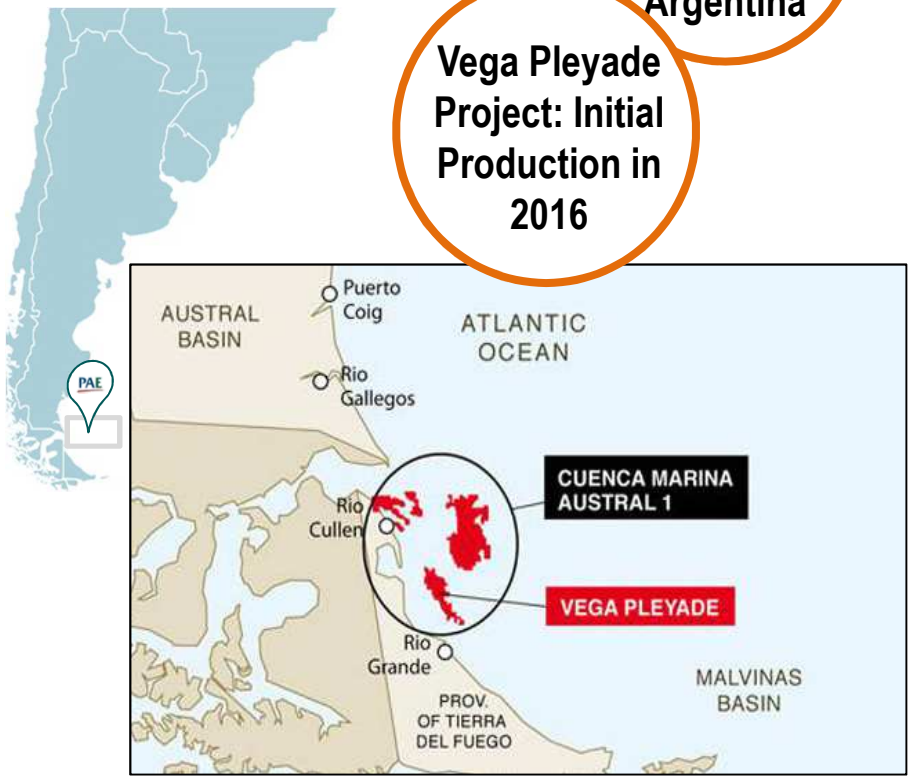


Imagen: Total Austral

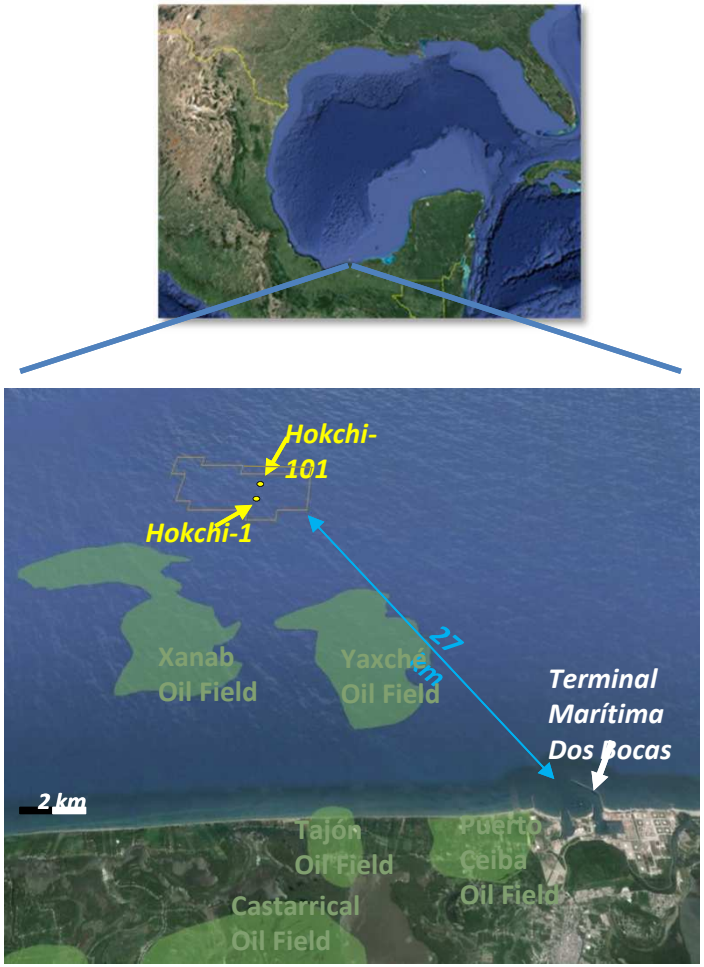
Hokchi

Evaluation period: completed

- Activity:
  - ✓ 3D Seismic Reprocessing
  - ✓ 5 delineation wells
  - ✓ 2 well production tests
  - ✓ G&G Studies
  - ✓ Screening Study and Engineering

Development Plan

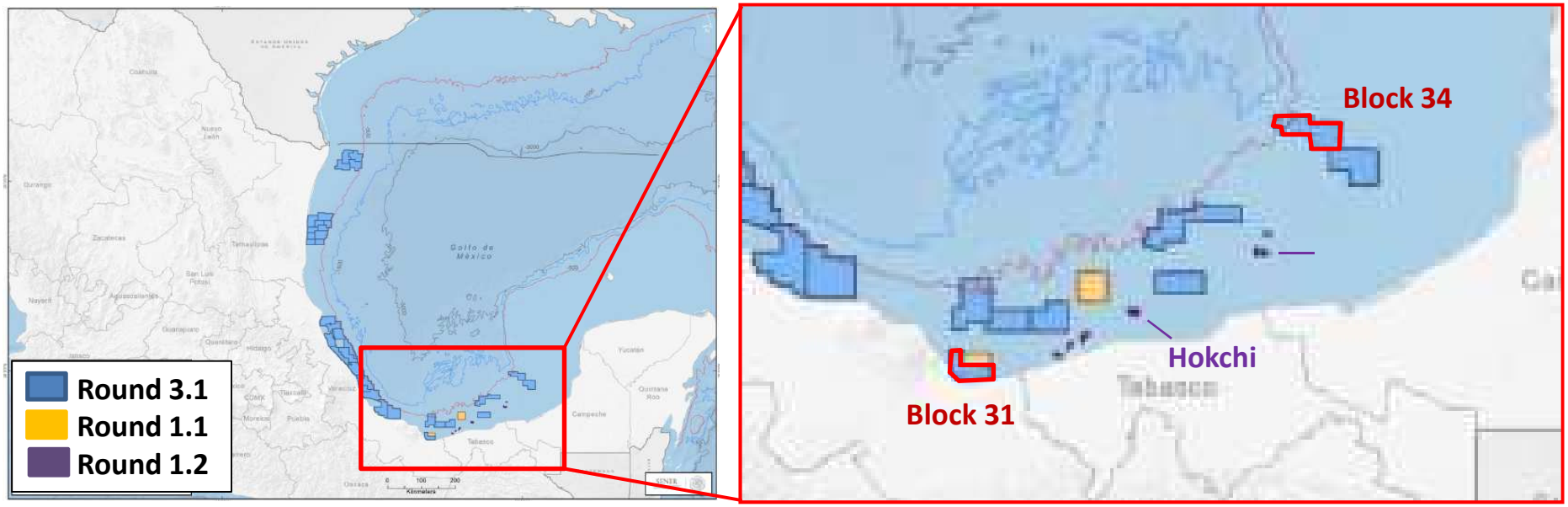
- Facilities construction:
  - ✓ 2 Unmanned Well Head Platforms: Central-16 slots and Satellite-6 slots
  - ✓ On-Shore Facilities: Oil Treatment Plant, Water Treatment/Injection Plant, Gas Compression / Treatment and Power Generation
  - ✓ Pipelines
- First production: May-2020



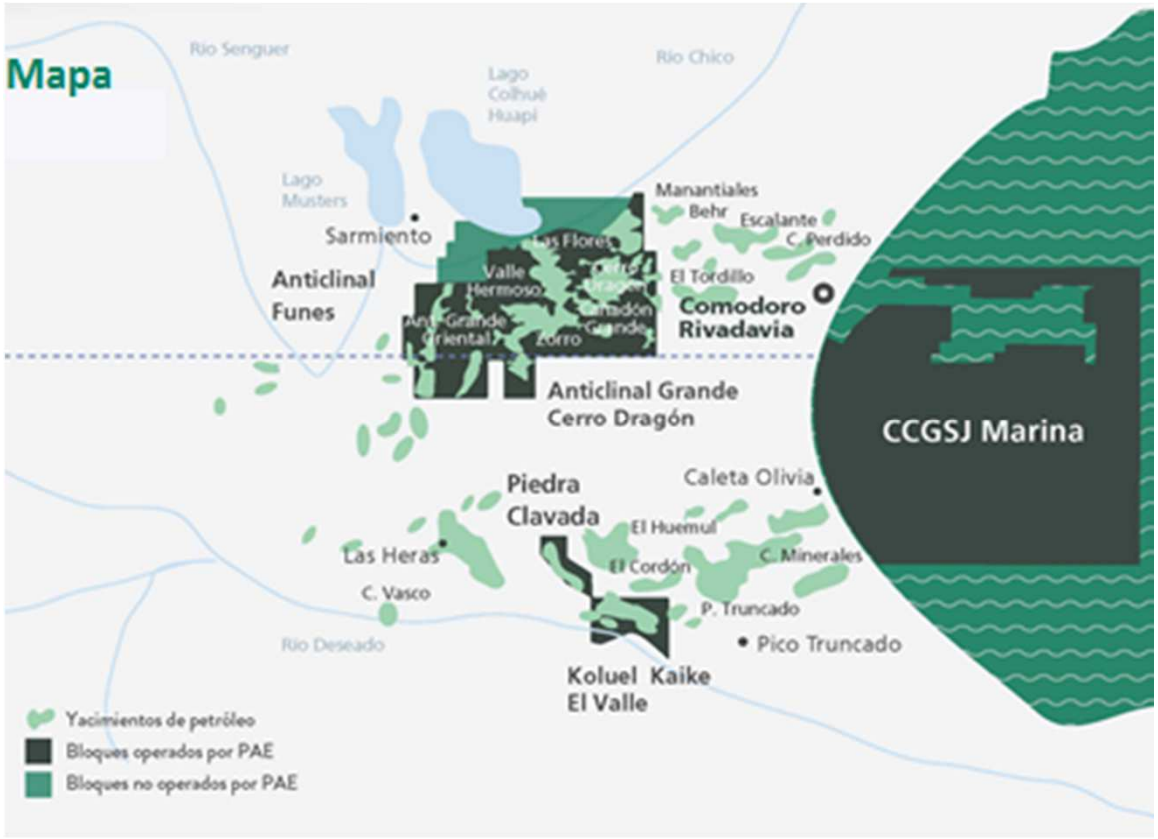
Mexico – Round 3.1

- **PAE was awarded in Exploration Blocks 31 and 34:**
  - Block 31: PAE 100% WI
  - Block 34: PAE 15% WI JV with BP and TOTAL

- **Commitment for each block :**
  - Seismic reprocessing
  - 1 Exploratory well



GSJ



3.564
Active Producing Wells

763 Injector wells

94,5 *Mbopd*
Oil production

1.336,1 *Mbpd*
Fluid

299,13 *MMcfd*
Gas production

176,40 *MMcfd*
Gas sales

1.241,6 Mbpd
Water Injection

1958 *(Amoco)*
Acquisition date

3.480 *Km²*
Surface area

8 Districts

7.880
Employees:
(PAE + Contractors)

3.456
Vehicles

86.181.109
Km traveled:
(Over the past 12 months)

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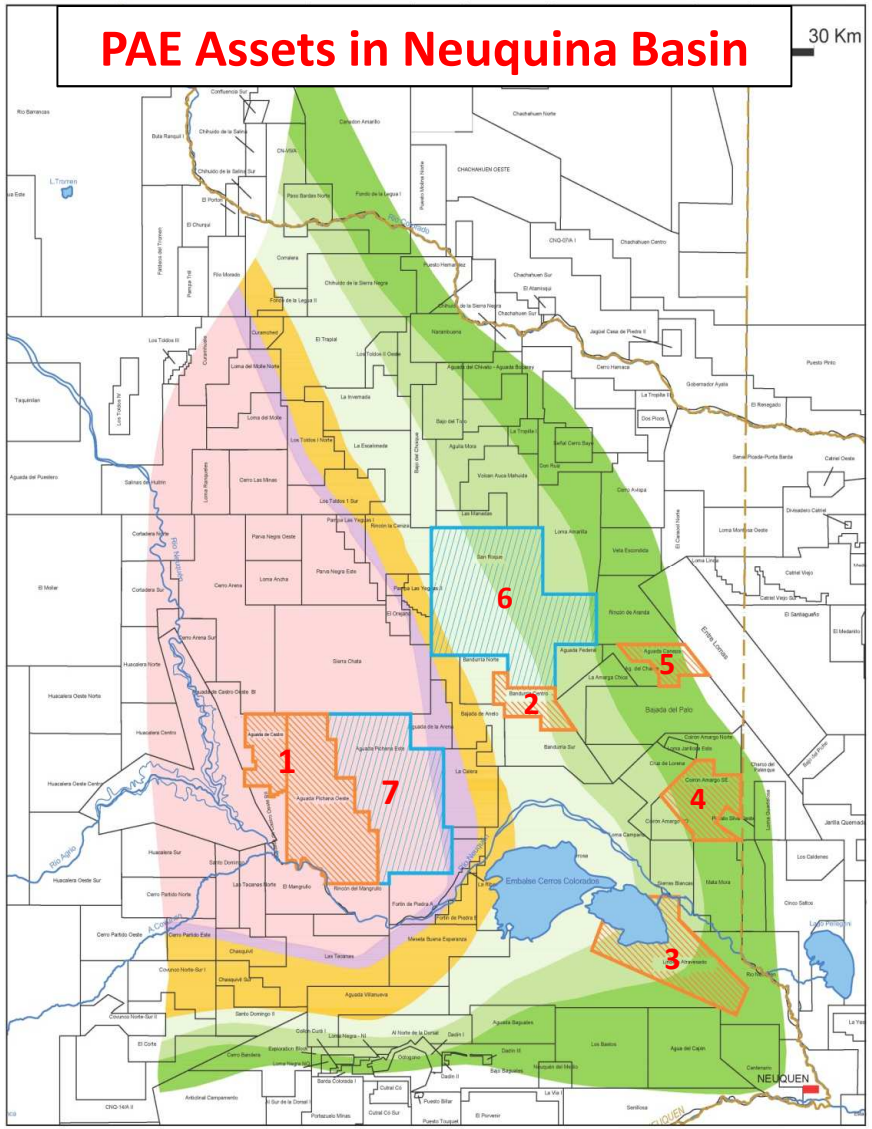
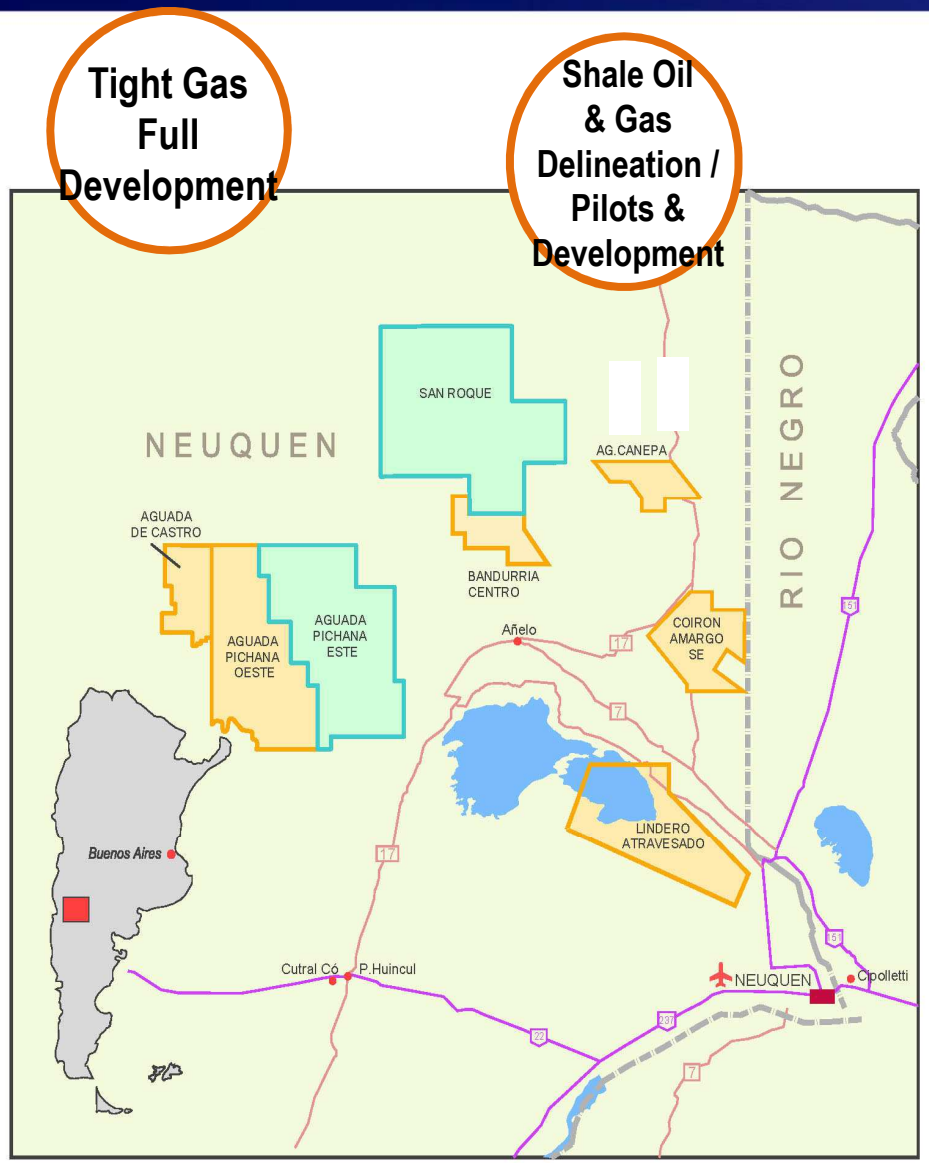
What we are doing – PAE's Unconventional Participation

- PAE is currently performing exploration, delineation, pilots & full development of Vaca Muerta ("VM") Fm. and the Grupo Cuyo within the following blocks:
- PAE as Operator
    1. Aguada Pichana Oeste & Aguada de Castro
    2. Bandurria Centro
    3. Lindero Atravesado
    4. Coirón Amargo Sur Este
    5. Aguada Cánepa
- PAE as Non Operator
    6. San Roque
    7. Aguada Pichana Este
- PAE's Total net Acreage: 327,097



May, 2018

What we are doing - PAE's Activity in Unconventional Plays



LINDERO ATRAVESADO (op.)

Tight gas Development +100 vertical wells drilled, average depths of 4200m. New facilities built. First horizontal well in VM to be drilled during 2018

BANDURRIA CENTRO (op.)

Shale oil Pilot Project currently on going. EPF under construction. First tight gas well drilled.

COIRÓN AMARGO SE (op.)

Two re-entries in existing well in VM shale oil (1500 m drain) completed and producing.

AGUADA PICHANA OESTE – AGUADA DE CASTRO (op.)

Pilot Project on going – first gas since 27th April 2018

AGUADA CÁNEPA (op.)

Partnership with GyP for shale oil exploration.

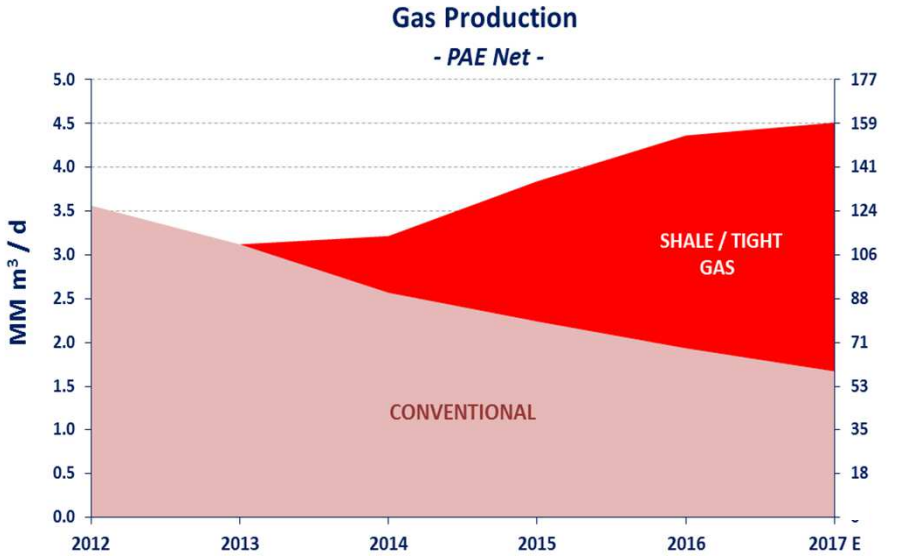
AGUADA PICHANA ESTE

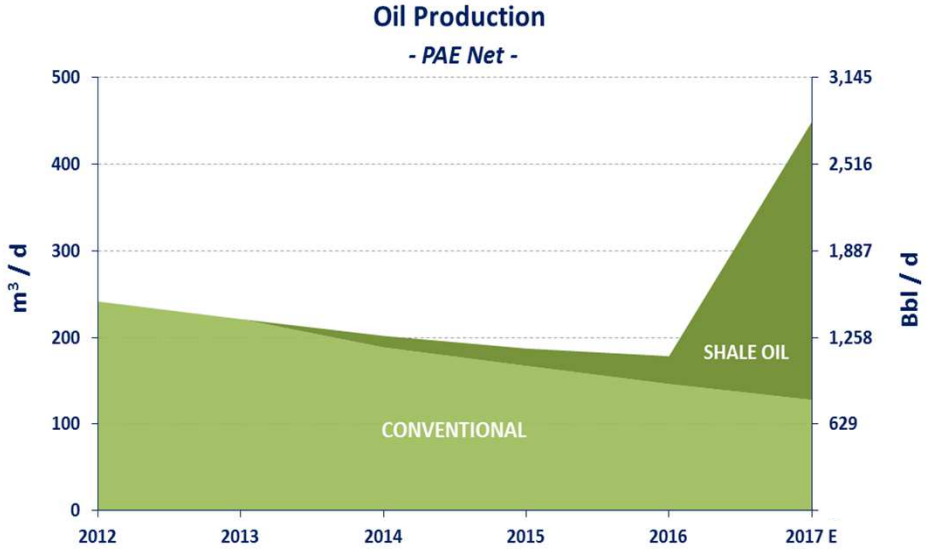
Tight Gas & Shale Gas Pilot Projects completed. Phase 1a of Full Development ongoing

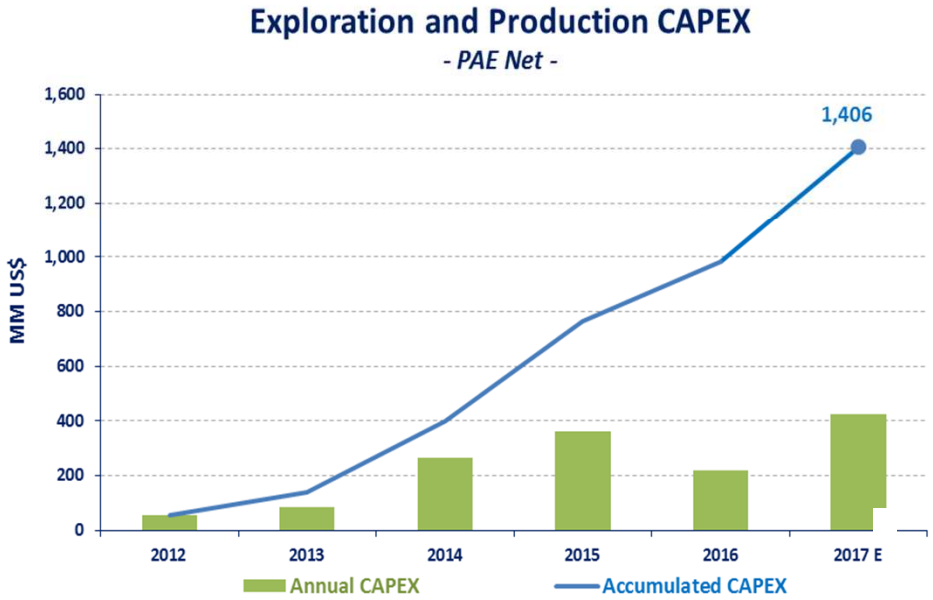
SAN ROQUE

First shale oil PADs drilled

How we are doing it – PAE's Activity Indicators in Unconventional







How we are doing it - PAE's Wells Main Parameters

SHALE OIL & GAS Objectives

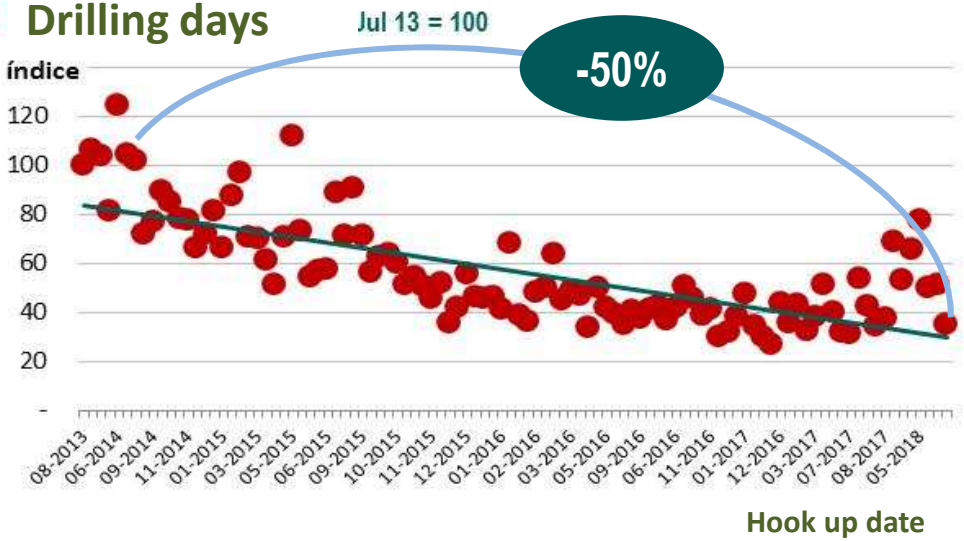
WELL TYPES	Wells 2017	Measure Depth [Feets]	Sxs/ Well	# Stages	Technology	KLbs \Stg	Lbs/Feet	Volume [m3/Well]	Completion Time [Days]
VM–Hztal-1500	2	14850	108345	60	Anular Frac	199	2413	26100	18
VM- Hztal–2000	5	16830	144460	80	Anular Frac + 20 Ball Sleeves	199	2413	34800	20
VM- Hztal–2500	1	18150	180575	100	Anular Frac + 20 Ball Sleeves	199	2413	43500	22

TIGHT GAS Objective

WELL TYPES	Wells 2017	Measure Depth [Feets]	Sxs/ Well	# Stages	Technology	KLbs \Stg	Lbs/Feet	Volume [m3/Well]	Completion Time [Days]
Tight –Vert-Lajas Oriental	10	14520	20351	8	P&P	299	NA	3914	11
Tight –Vert-Lajas Occidental	8	15180	27490	10	P&P	303	NA	6000	15
Tight-Hztal-1000	2	18120	34015	11	P&P	357	1136	6400	18
VM-Hztal-1500	2	16000	108345	60	Anular Frac	199	2413	26100	18

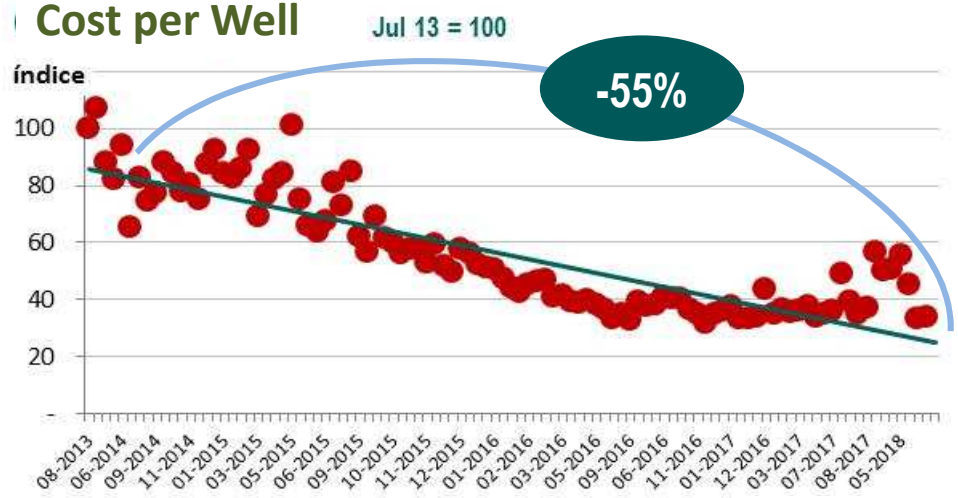
How we are doing it – Unconventional Efficiency Improvement

Drilling days



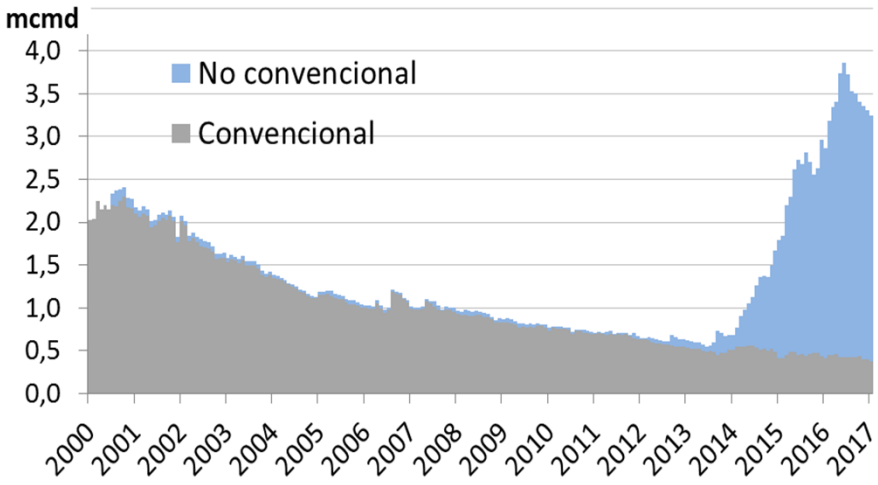
Hook up date

Cost per Well



Hook up date

Producción de gas (Gross)



Main Highlights

Operational Optimization & Technology

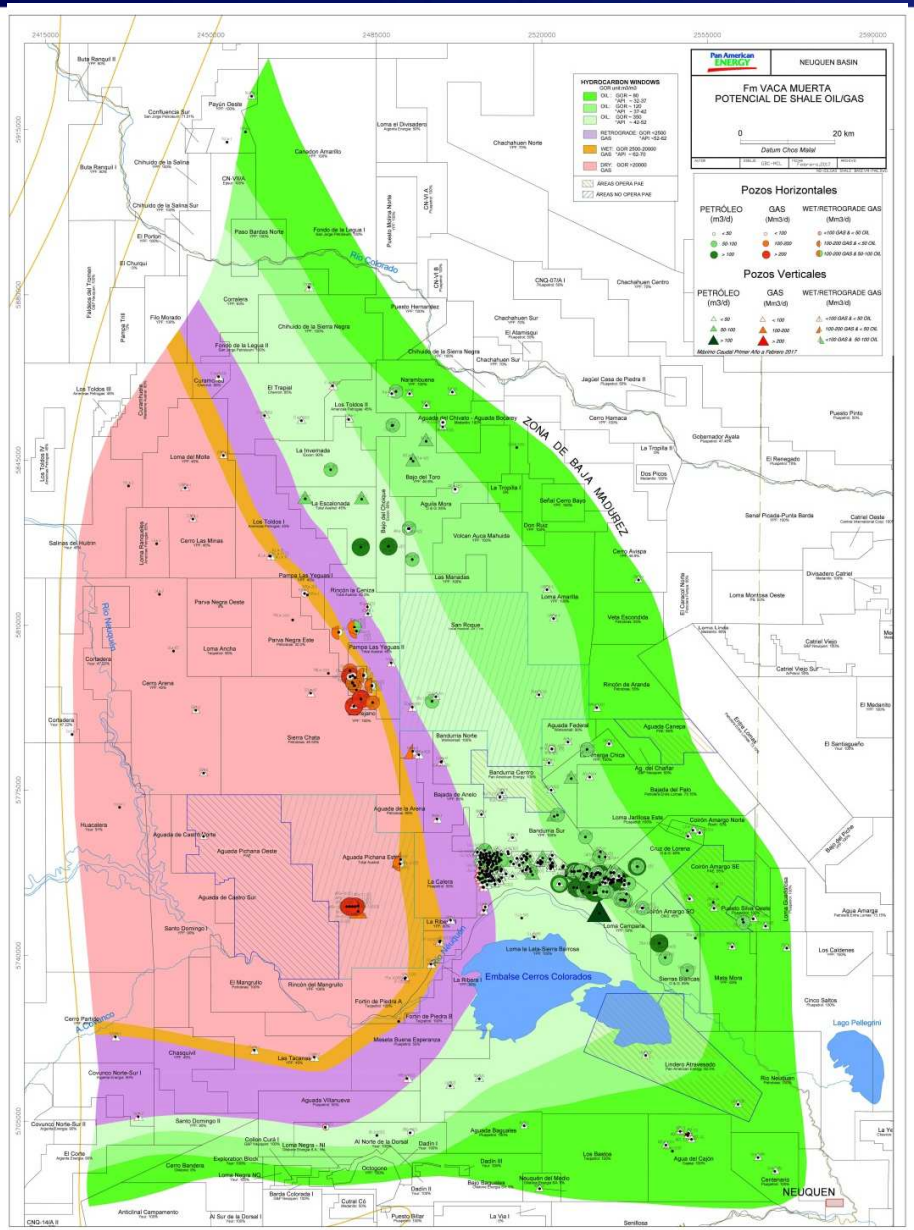
- Incorporation of drilling rig with *walking system*
- Switched from Water-Based-Mud to Oil-Based-Mud in intermediate and productive sections
- Switched to *Factory Model,* drilling multipad wells
- Use of sliding sleeves technology for annular fractures

Logistics

- Direct purchase of massive consumption products (frac sand, mud products, others)

Future Challenges - Unconventional Sizing of Future Activity

Future Activity for Unconventional Resources is estimated in the need of 39.000 new wells



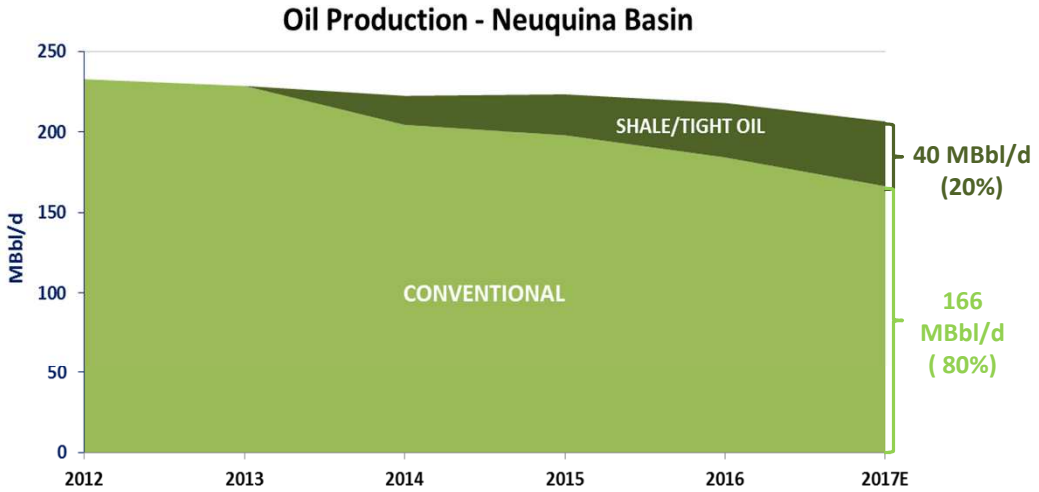
- The Neuquina Basin is considered a World Class Unconventional Play not only for the VM Fm, in terms of both shale oil and shale gas, but also for the tight gas potential in the Grupo Cuyo and Los Molles Fm.
- The VM Fm extends along an area in the range of **30,000 Km2**
- VM depths ranges +/- 3000 mts.

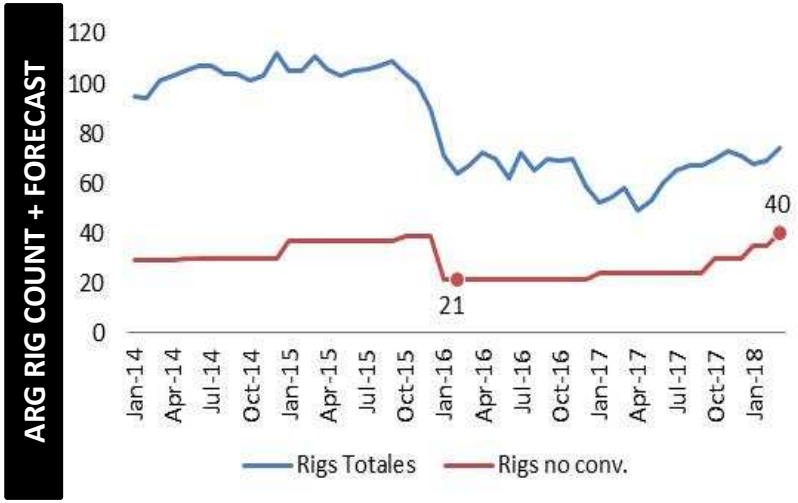
 # wells by oil and gas windows

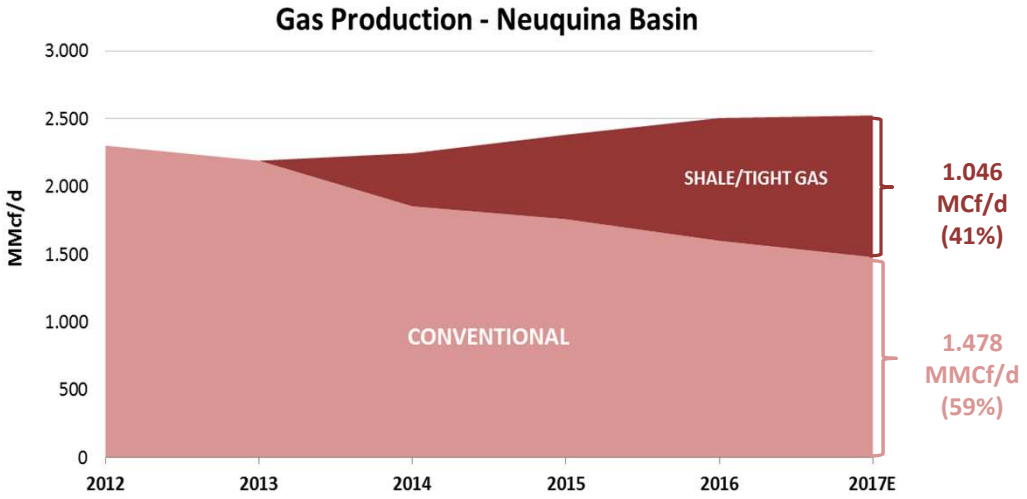
	Superficie (km2)		Densidad (Acres/pozo)	Probabilidad de Desarrollo	Cantidad de Pozos
	Total	Perforable			
Grupo Cuyo 1	49	49	40	100%	**300**
Grupo Cuyo 2	65	65	40	100%	**400**
TOTAL TIGHT					**700**
VM DRY GAS	7.564	4.787	140	87%	**7.320**
VM WET GAS	2.278	1.660	100	100%	**4.101**
VM OIL 1	4.315	2.815	80	100%	**8.690**
VM OIL 2	3.783	2.400	80	100%	**7.410**
VM OIL 3	5.962	4.431	80	50%	**6.841**
TOTAL VM	**23.902**	**16.094**			**34.362**
LOS MOLLES	2.877	2.877	180	100%	**3.948**

Future Challenges - Unconventional Sizing of Future Activity

Despite that unconventional developments in Argentina are at is early stage the production and activity has increase during the last four years.







Several tenders for new rigs are currently undergoing increasing the rig count from 35 to 40

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Future Challenges - Unconventional Developments

- We are in the right direction in terms of improving efficiency but there is still lots of work to do.

- All players need to look for sensible and realistic solutions in order to allow the full hydrocarbons devolpments of the unconventional resources.

A joint effort which should involve all industry players: operators, contractors/suppliers, unions, provincial and federal governments.

Hydrocarbon Producers and its Production Chain:

Efficiency improvement, in order to allow more development projects to be carried out. We should work in the contract services focused on efficiency, including variable rates subject to productivity.

Increase amount of Operators and its productive environment. We think that the industry has a long way to go. More competition should be generated. In the meantime the industry should continue working with suppliers looking for efficiency through tasks' standardization and rationalization.

Reach a higher level of technical & geological knowledge required for these type of developments.

All players, specially our contractors, small and medium-sized companies ("Pymes"), suppliers, etc, should understand that this type of developments have a marginal gain and that benefits come with sustainability, and, in the long term, sustentability of the business.

New service companies willing to arrive to Argentina will have the chance to work in an environment with aggressive growing activity

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Future Challenges - Unconventional Developments

Unions:

- Are called to take part in this challenge by working in continuous improvement of efficiency and social peace. Without this compromise, it will be very difficult to maintain the activity levels.
- By improving work productivity new genuine jobs will be created.

Provincial & Federal Governments:

- We understand that the role of the State is to create conditions that will provide for a more competitive environment for the industry. This requires a huge rationality and effort in order to align the regulations with the requirements of sustainability that needs VM for the development of the country.

➢ *Unconventional Development is at a stage of take-off and there is a lot of work to be done.*

➢ *We are still learning about geology and well productivity. VM sweet spot are yet to be determined and we are still developing and testing the appropriate techniques for such developments.*

➢ *The industry needs to face the extraordinary challenge of developing these resources in order to meet the energetic growth of the country, to create new jobs and, of course, to increase the wealth of the Province and the country itself.*

➢ *If compared to the USA, we are still at an early stage of the learning curve when it comes to reaching the technical capacity and the adequate geological knowledge of this type of resources.*

➢ *We should assume that our* competitiveness *level still needs a fast and full improvement. The gap in efficiency and costs that separates us from more competitive international producers is still broad.*

➢ *With focus in the long term, we should work together in order to reach the above mentions standards.*

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Thank You


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